



## Marine Safety Center Technical Note

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MTN 02-11  
16710/Automation/DP  
December 15, 2011

Subj: REVIEW OF VITAL SYSTEM AUTOMATION AND DYNAMIC POSITIONING  
SYSTEM PLANS

Ref: (a) Title 46 CFR Subchapter F – Marine Engineering  
(b) Title 46 CFR Subchapter J – Electrical Engineering  
(c) Navigation and Vessel Inspection Circular (NVIC) No. 2-95 Change-2, *The Alternate Compliance Program (ACP)*  
(d) Use of Dynamic Positioning (DP) by Offshore Supply Vessels (OSVs) for Oil and Hazmat Transfers, Eighth Coast Guard District (D8(m)) Policy Letter 01-2003, 22 January 2003

1. Purpose: This Marine Safety Center Technical Note (MTN) provides guidance for the preparation of shipboard vital system automation plans and dynamic positioning (DP) system plans submitted to the Marine Safety Center (MSC) for approval, or to an Authorized Classification Society (ACS) conducting review of these systems on behalf of the Coast Guard.

2. Discussion:

- a. References (a) and (b) establish the minimum requirements to ensure the safety of a vessel with automated vital systems is equivalent to that of a vessel with vital systems under direct manual control. ACSs use their respective rules and USCG Supplement when reviewing automated vital systems on behalf of the Coast Guard under reference (c). However, the MSC plan review requirements for these systems are not concisely discussed in any one document. As such, the guidelines provided in Enclosure (1) clarify existing plan review requirements for vital system automation plans.
- b. DP systems are considered to be a vital component of the propulsion control system and are fully integrated with the vessel's power management system. DP systems are routinely used as the primary maneuvering system during critical operations, such as those involving close quarters hazardous cargo and personnel transfers, and station-keeping during exploration, drilling, production and oil transfer operations. The failure of primary and/or back-up power systems may cause the failure of DP systems, or a failure in the DP systems may negatively impact primary power systems. Accordingly, any review of vital system automation plans should include a full review of the entire DP system. Guidelines for the preparation of DP system plans are provided in Enclosure (2).

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- c. Shipboard machinery and electrical systems are becoming more automated. Shipboard vital automation systems have essentially become the nerve system for the entire vessel, monitoring and continuously adjusting all systems capable of remote operation. Programmable logic controllers, sensors, centralized machinery monitoring and control systems, power management systems, and propulsion control systems are integrated using multiple ship-wide computer networks. A failure of a single component previously viewed as a minor event may now result in an unforeseen power loss affecting vital systems. Although testing required by manufacturers, shipyards, ACSs, and owners is conducted prior to vessel delivery, these tests are usually operational in nature, completed at separate times, and often do not adequately cover failure modes. Because of this, and in light of several marine casualties involving vital system automation and/or DP systems, the Coast Guard has increased the level of technical review it performs on all plans and testing procedures associated with these systems. As a result, the Qualitative Failure Analysis (QFA), Design Verification Test Procedures (DVTP), and Periodic Safety Test Procedures (PSTP) required by reference (a) have become comprehensive documents which can be difficult to prepare, review, and approve. The guidelines for the preparation of these documents provided in both Enclosures (1) and (2) are intended to streamline plan review, testing, and approval of these systems.

3. Applicability: This MTN applies to all vital system automation and DP system plans submitted to the MSC for approval, or submitted to an ACS conducting plan review on behalf of the Coast Guard. These guidelines do not preclude the OCMi from establishing additional requirements or restrictions which may be deemed appropriate or necessary.

4. Action: Vital system automation and DP system plans submitted to the MSC for approval, or submitted to an ACS conducting plan review on behalf of the Coast Guard, will be reviewed for compliance with the applicable regulations, this MTN, and any applicable requirements established by references (a) through (d). The plans must provide sufficient details to permit a complete review of all vital systems. Upon successful completion of plan review, the QFA, DVTP, and PSTP will be considered satisfactory for testing to be witnessed by the cognizant OCMi or designated ACS Surveyor. The MSC, or ACS conducting plan review on behalf of the Coast Guard, will not stamp such plans "Approved" until after the completion of testing and after the incorporation of any necessary changes identified during testing by the OCMi or ACS.

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5. Disclaimer: While the guidance contained in this document may assist the industry, the public, the Coast Guard, and other Federal and State agencies in applying statutory and regulatory requirements, this guidance is not a substitute for the applicable legal requirements, nor is it in itself a regulation. It is not intended to, nor does it impose legally binding requirements on any party, including the Coast Guard, other Federal agencies, the States, or the regulated community.



P. E. LITTLE

Encl: (1) Plan Submission Requirements for Vital System Automation  
(2) Plan Submission Requirements for Dynamic Positioning (DP) Systems

Copy: Commandant (CG-521), Office of Design and Engineering Standards  
Commandant (CG-522), Office of Operating & Environmental Standards  
Commandant (CG-543), Office of Vessel Activities  
Commandant (CG-546), Office of Quality Assurance and Traveling Inspection  
Outer Continental Shelf National Center of Expertise (OCS NCOE)  
American Bureau of Shipping (Houston)  
Det Net Veritas (Houston)  
Lloyd's Register of Shipping (Houston)  
Germanisher Lloyd (Houston)

## PLAN SUBMISSION REQUIREMENTS FOR VITAL SYSTEM AUTOMATION

1. General. To streamline plan review and facilitate approval, a single point of contact should submit all the necessary plans in one submittal. See 46 CFR 62.20 for plan submittal requirements. Plans submitted must provide sufficient detail to permit a complete review of all vital systems.

2. Vital System Automation QFA, DVTP and PSTP Submittals. The requirements for the Qualitative Failure Analysis (QFA), Design Verification Test Procedures (DVTP), and Periodic Safety Test Procedures (PSTP) in 46 CFR Subchapter F are often misconstrued to be exactly the same as Classification Society requirements for these documents. Although the requirements are very similar, there are distinct differences. Where Classification Societies accept Factory Acceptance Testing and Type Approval, 46 CFR 61.40 requires extensive testing beyond simple operational tests once the installation is complete. Classification Society Rules use the term Failure Mode and Effects Analysis (FMEA). A FMEA will be accepted by the Coast Guard as a QFA, if a qualitative analysis is included. The general guidance provided below should assist designers and submitters with meeting MSC plan review requirements:

- a. Qualitative Failure Analysis (QFA) – As per 46 CFR 62.20-3, the QFA is intended to assist in evaluating the safety and reliability of the design. The QFA is performed to determine the effects of individual component failures on Vital System Automation. The QFA should include information confirming that single non-concurrent failures in control, alarm, or instrumentation systems will not prevent sustained or restored operation. The lowest level of component failure required to be included in the QFA is each easily replaceable component. Typically this includes electronic circuit boards, power supplies, microprocessors, memory boards, input/output modules, microcontrollers, communication boards, circuit drivers, and similar circuit boards containing solid state devices. Relays, terminal boards, indicator lights, switches, wiring, meters, and instruments do not have to be included in the QFA unless their failure would lead to an unacceptable failure mode (e.g., not fail-safe).
- b. Design Verification Test Procedures (DVTP) – The DVTP is a detailed test procedure to verify each failure mode identified in the QFA. Each test should include: (1) safety precautions, (2) equipment status prior to testing, (3) equipment required to perform the test, (4) control or alarm set-points, (5) test procedure to be followed, (6) expected results, and (7) space for the cognizant OCMI or ACS Surveyor to record results during testing.
- c. Periodic Safety Test Procedures (PSTP) – Originally the PSTP was limited to boilerfront automation. With fully automated propulsion plants, including installations approved for periodically unattended operation, the PSTP has increased considerably in scope. Similar to the DVTP, each test should include: (1) safety precautions; (2) equipment status prior to testing; (3) equipment required to perform the test; (4) control or alarm set-points; (5) test procedure to be followed; (6) expected results; and, (7) space for OCMI or ACS Surveyor to record results during testing. The PSTP must include primary and alternate controls, power sources, transfer of

control and override, interlocks, and safety controls for propulsion systems. The PSTP must also include test procedures to prove safe operation of fire detection and extinguishing systems, alarm and monitoring systems, steering gear control systems, ship's service and emergency generators, and emergency internal communications (e.g., sound powered telephones, EOT, dead man alarm, engineers' assistance needed alarm, etc.).

For further guidance in preparing QFA, DVTP and PSTP documents, see the Marine Safety Center website available as a featured link at <http://homeport.uscg.mil/>. Click on the Marine Safety Center link located under "Featured Homeport Links." Once on the MSC website, click on Plan Review Guidelines under the "References" section. The Plan Review Guidelines titled "E2-01 Vital System Automation", "E2-17 Periodic Safety Test Procedures", and "E2-18 Qualitative Failure Analysis" will assist with preparing QFA, DVTP, and PSTP documents. If you have further questions or comments, please contact the MSC Electrical Branch at 202-475-3402 or email [MSC@uscg.mil](mailto:MSC@uscg.mil).

## **PLAN SUBMISSION REQUIREMENTS FOR DYNAMIC POSITIONING (DP) SYSTEMS**

1. General. To streamline plan review and facilitate final approval, a single point of contact should prepare and submit all the necessary plans in one submittal. To facilitate the plan review process, submitters may submit plans using IMO MSC/Circular 645 Guidelines for Vessels with Dynamic Positioning Systems as the baseline for the design, or cite the relevant Classification Society Rules used for the design. Plans for the following system components should be submitted at a minimum:

- a. DP Control System
- b. Automated Power Management System
- c. Power Generation and Distribution
- d. Thruster Control System
- e. DP System Operating Manuals
- f. DP System Failure Mode and Effects Analysis (FMEA)
- g. DP System Proving Trial Test Procedure
- h. DP System Periodic Test Procedure

2. DP System Plan Review. Plan review for DP Systems is performed under 46 CFR Part 62 since this system is considered part of vital system automation (refer to Enclosure (1) for guidance regarding vital system automation plans). General guidance to assist with DP System design and plan review is provided below:

- a. The DP Control System plans should include information for (1) required redundancy, (2) operator interface, (3) alarms and warnings, (4) position reference systems, and (5) vessel sensors.
- b. The Automated Power Management (APM) System plans should demonstrate capability to maintain continuity of power while responding to DP System power demands.
- c. The Power Generation and Distribution plans should demonstrate the required redundancy.
- d. The Thruster Control System plans should demonstrate required redundancy for the (1) thruster auxiliaries, (2) emergency shutdown circuitry, and (3) manual controls.
- e. The DP System Operating Manual should contain operating guidance which is consistent with the system configuration.
- f. DP System Failure Mode and Effects Analysis (FMEA) will be reviewed for required system redundancy and ability of the system to maintain station-keeping capability following any single point failure.
- g. The Dynamic Positioning System Proving Trial Test Procedure should ensure all failure modes identified in the FMEA are tested and the methods for testing will realistically simulate the failure.
- h. The DP System Periodic Test Procedure should ensure all systems are tested to demonstrate that the system is fully operational. Periodic testing should include all possible modes of operation since crew training and assessment is one of the benefits of performing periodic testing.

3. DP Systems On Mobile Offshore Drilling Units (MODUs). On March 25, 2011, the Coast Guard published new guidance for DP systems and automatic power management (APM) systems for MODUs. This guidance states:

“Failures of DP systems or the automatic positioning system they rely upon can cause a MODU to drive or drift off station, potentially causing damage to subsea equipment and result in a subsea oil spill. As per paragraph 4.12 of the 1989 MODU Code (as amended), where DP systems are used as the sole means of station keeping, they should provide a level of safety equivalent to that provided by anchoring arrangements. As a Coastal State, the U.S. interprets this requirement to mean that DP systems operating on U.S. MODUs and foreign MODUs operating on the U.S. Outer Continental Shelf meet, as a minimum, the requirements of equipment class 2 as described by IMO MSC/Circular 645. Accordingly, plans for MODUs submitted to the MSC or an ACS for Coast Guard approval must demonstrate that if any component of the DP system fails the MODU will not lose position.”

MODU plans submitted to the MSC or ACS will be reviewed according to this policy. Use of open bus architecture is preferred unless it can be proven that closed bus operation will not degrade the safety, redundancy, or reliability of the system.

For further guidance in preparing DP system submittals, please go to the Marine Safety Center website available as a featured link at <http://homeport.uscg.mil/>. Click on the Marine Safety Center link located under “Featured Homeport Links.” Once on the MSC website, click on Plan Review Guidelines under the “References” section. The Plan Review Guideline titled “E2-24 Dynamic Positioning Systems” will assist with preparing a DP system plan submittal. If you have further questions or comments, please contact the MSC Electrical Branch at 202-475-3402 or email [MSC@uscg.mil](mailto:MSC@uscg.mil).